Department of Computer Science and Engineering
Faculty of Engineering, University of Moratuwa

CS4342 Advanced Computer Architecture

2014 Batch Semester 7 (Feb - June 2018)

Class LMS	https://online.mrt.ac.lk/course/view.php?id=8747
Schedule	Mondays between 1:15pm – 3:15pm at CSE Dept. (14 sessions)
Instructors	Dr. Dilum Bandara, dilumb@cse.mrt.ac.lk, 011-265-0152
Prerequisite(s)	CS2052 or EN2022. Students should have a background on fundamentals of computer organization and programming. This background should include a good understanding of the internals of microprocessors (ALU and logic unit), instruction set architecture, memory management, and I/O. Background in Assembly, C, and C++ programming is useful.
Text	Computer Architecture – A Quantitative Approach by J. L. Hennessy and D. A. Patterson, 5th edition, (2012), Morgan Kaufmann, or 6th Edition which is now available Other reading: • Course notes • Relevant research papers
Assessment	Distribution of marks is as follows: • Group presentation 15% • Take home labs (4) 20% (5 × 4) • Class contributions 5% • Quizzes – based on assigned readings (2) 10% (5 × 2) • Final Exam (closed book) 50% In a group of 2 or 3, students will study an approved topic, present it in the class (15 + 5 minutes), and discuss in the LMS. The details will be provided.
Course Objectives	To provide a quantitative and qualitative understanding of trade-offs and design considerations in the design of superscalar, Instruction Level Parallel (ILP) microprocessors, multi-processors, and many-core processors. At the end of the module, you will be able to explain the design concepts and considerations behind today's microprocessors, memory systems, and power efficient computing. Moreover, you will be able to analyse the performance of real world, uni/multi/many-processor systems, identify their performance bottlenecks, and evaluate and apply those design concepts to solve some of the real-world problems. Required readings, in-class presentations, labs, and discussions will enhance both the analytical and soft skills.
Syllabus	The goal for the class is to explore the selected topics in detail. Our plan is to touch upon the following areas. This is a tentative list of topics that might be covered in the class; we will select material adaptively based on the background, interests, and rate of progress of the students.

#	Date	Topic
1	Feb 26	1. Fundamentals of computer organization • ALU and control unit • Instruction set architecture
2	Mar 5	

3	Mar 12	2. Instruction-level parallelism • Simple pipelined RISC processors and its extensions
4	Mar 19	• Branch prediction techniques
5	Mar 26	• Static and dynamic scheduling • Multithreading
6	Apr 2	3. Data-level parallelism [3 classes] • Vector processors • SIMD
7	Apr 23	• GPU architectures • Loop-level parallelism
8	May 7	4. Memory hierarchy • Caching
9	Alternative class	• Advanced cache optimization techniques • Virtual memory
10	May 14	5. Thread-level parallelism • Multi-processors • Shared-memory architectures • Memory synchronization
11	May 21	6. Mobile Processor Architectures
12	May 28	7. Warehouse-scale computers • Cloud computing • Programming models
13	June 4	2. Green computing 3. Students Presentations
14	June 11	4. Students Presentations (cont.)

Workload Expectations

There is a normative workload expected of you while following this module. This is a 3-credit module. For the average student, this means 135 study hours over the semester. The following table provides a rough breakdown of how these hours might be spent over the whole semester – but this is only for guidance:

Attendance	
14 weeks × 2-hour lectures	28
Independent work	
Preparatory work – e.g., set reading, checking LMS announcements, preparation for lectures and labs 14 weeks × 4 hours a week	56
Group work	
Presentation	10
Take home labs (8 × 4)	32
Assessment	
Exams (Quizzes are included in lecture slots)	2
Remaining hours are likely to be used for assessment activities, e.g., exam revision, extra reading and coursework planning and writing	7
TOTAL	**135**

Class policies

- Topics to be discussed in each class will be posted on Moodle, along with relevant readings for each topic. You are expected to keep up with the readings as we go, as they will help provide the foundation for the homework, quizzes, and exam. Impromptu quizzes will be based on these assigned readings.
- All students are expected to actively participate in class and Moodle activities. Poor participation and/or poor performance in assigned course work can be grounds for failure in the course.
- University rule of 80% attendance will be strictly enforced.
- Discussing and exchanging ideas through study groups are encouraged, as this usually leads to a better depth of understanding. As part of the discussions, you may share ideas and thoughts, discuss the meaning of homework questions, or possible ways of approaching a solution. However, you must write homework solutions strictly. If one of your solutions is based on a key idea of someone else, you must acknowledge this in your homework, to avoid the perception of cheating. This form of collaboration is not an opportunity to copy answers from others.
- Group assignments are given to encourage teamwork and discussion/toleration of alternative ideas/views; hence, they need to be done as a group. A penalty will be enforced for doing group assignments individually.
- Plagiarism, copying another person's work, letting another person copy your work, giving or receiving aid during any test or examination is all strictly not allowed. Any student caught in any of these will receive a failing grade regardless of marks earned on other assessed work.
- Proper netiquette should be observed in using the Moodle.
- Each assigned work will have either a deadline for submission or a specific date for performance. For each day delayed beyond a deadline, 10% of marks will be deducted. Not performing (e.g., not doing a presentation) on an assigned date will result in 0 marks unless there is a valid reason and another student/group is arranged as a replacement. Details of submission will be given with each assignment. All assignments must be submitted via the Moodle.
- The dictionary meaning of deadline is "the latest time or date by which something should be completed". Thus, as you may already experience during internship, deadlines are supposed to be met.
- All quizzes and final exam are closed book and closed note exams. The final exam will be comprehensive, covering material from the entire course including in class and Moodle discussions.
- You may not use cell phones, mp3 players, etc., during the class. All laptops, smart phones, and tablets must be closed, unless you use it to take notes or search for additional contents relevant to the ongoing class discussion. The reason is to prevent distractions to other students, and to prevent the temptation to check email, Facebook, etc.